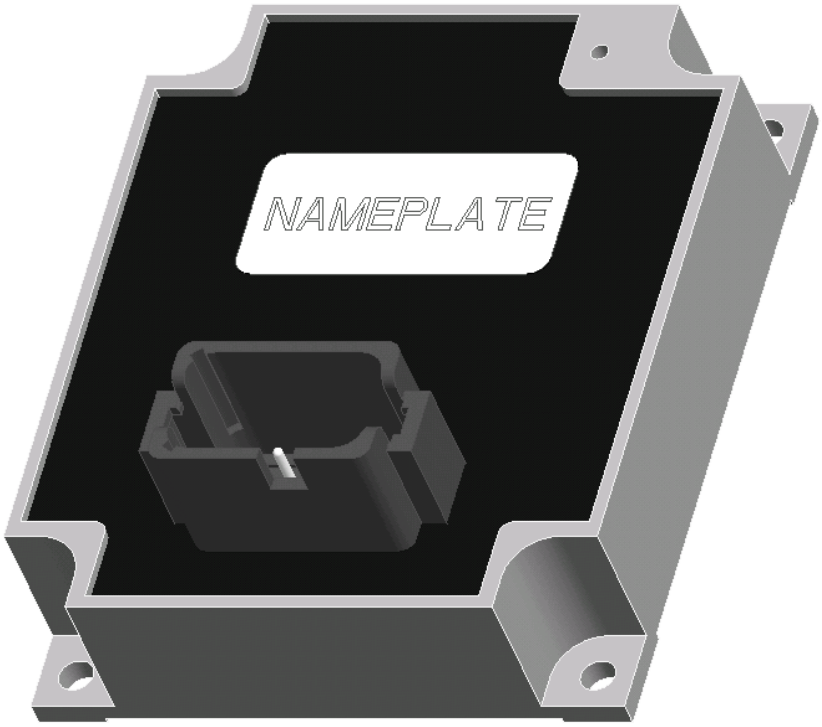
WOODWARD

Product Manual 26283
(Revision NEW)
Original Instructions



In-Line Power Module for use with L-Series Actuators

Installation Manual

IMPORTANT

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DEFINITIONS

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

WARNING

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, be sure to check the *publications page* on the Woodward website:

www.woodward.com/publications

The current revision and distribution restriction of all publications are shown in manual *26311*.

The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

NOTICE

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Contents

Illustrations and Tables

Electrostatic Discharge Awareness

All electronic equipment is static-sensitive, some components more than others. To protect these components from static damage, you must take special precautions to minimize or eliminate electrostatic discharges.

Follow these precautions when working with or near the control.

1. Before doing maintenance on the electronic control, discharge the static electricity on your body to ground by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).

2. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.

3. Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cup holders, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, and plastic ash trays) away from the control, the modules, and the work area as much as possible.

4. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:

    - Do not touch any part of the PCB except the edges.

    - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.

    - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Chapter 1.
General Information

Purpose and Scope

The purpose of this manual is to provide the necessary background information for applying the In-Line Power Module to the L-Series actuator, used on reciprocating engines. Topics covered include mechanical installation and electrical wiring. While this manual is primarily targeted at OEM customers, OEMs themselves may find it useful to copy some of the information from this manual into their application user manuals.

How to Use This Manual

The following summarizes how to install a power module into a new or existing system:

- Unpack and inspect the hardware.
- Mount and wire the hardware following the procedures and recommendations in Chapters 2–3.
- Specifications are provided in Appendix B.

Intended Applications

The in-line power module is aimed at reducing transient line conditions that can be harmful to the power supply inputs of an L-Series control in an engine installation. The power module suppresses destructive high-voltage transient signals that might occur as a result of an alternator load dump, an indirect lightning strike, among others. This module will also handle up to 80 Vdc steady-state input voltage for NO LONGER THAN 2 minutes to allow for jump-starting of an engine.

Key environmental characteristics of this application include extended industrial operating temperatures (–40 to +105 °C/–40 to +221 °F), industrial EMC requirements, marine agency requirements, and electrical transients.

IMPORTANT **This power module does not protect the I/O lines of the L-Series actuator. It is only applicable to the power supply inputs.**

Chapter 2.
Installation

Safety Information

⚠WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

⚠WARNING

Use an independent device for positive shutdown, such as a fuel shut off valve is highly recommended. Failure to comply with this recommendation can cause personal injury and/or property damage.

Use of an external spring to return to minimum fuel is highly recommended. Failure to comply with this recommendation can cause personal injury and/or property damage.

Use of a predicted minimum fuel shutdown procedure is highly recommended. Failure to comply with this recommendation can cause personal injury and/or property damage.

⚠WARNING

External fire protection is not provided in the scope of this product. It is the responsibility of the user to satisfy any applicable requirements for their system.

⚠WARNING

The use of proper wire type and wiring practices is critical to operation.

⚠CAUTION

Due to typical noise levels in engine environments, hearing protection should be worn when working on or around the power module.

⚠CAUTION

Surfaces can become hot enough or cold enough to be a hazard. Use protective gear for product handling in these circumstances. Temperature ratings are included in the specification section of this manual.

NOTICE

Do not connect any cable grounds to “instrument ground”, “control ground”, or any non-earth ground system. Make all required electrical connections based on the wiring diagrams in Chapter 3.

Unpacking

Be careful when unpacking the module. Check the unit for signs of damage, such as bent or dented panels, scratches, and loose or broken parts. Notify the shipper and Woodward if damage is found.

Chapter 3.
Power Module Electrical Installation

Introduction

This chapter provides instructions on how to connect the in-line power module into a system using an L-Series actuator. A wiring pinout of the power module, as viewed by looking into the connector feature, is shown in Figures 3-1a and 3-1b. Typical connections to external devices are also shown.

The power module has an operating voltage range of 18 to 32 Vdc, and can handle up to 80 Vdc for periods of NO LONGER THAN 2 minutes. It is reverse-input-polarity protected, and consumes approximately 36 W maximum power at a peak current of 2 A (18 V) at 25 °C (when driving an L-Series actuator). Maximum power at the power module is only realized if the actuator is in a failed condition (jammed, or otherwise driven against a stop at maximum current).

The control system should be protected with a 6 A fuse in the voltage supply lines. The application should be configured to turn on power to the power module when the engine is first cranked, or slightly before.

Electrical Connections

⚠WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

Prior to installation, refer to the wiring diagrams and the representative I/O interfaces schematic in this chapter. Also, review the hardware I/O specifications in Appendix B.

NOTICE

The control will only meet ingress protection specifications while the Deutsch connector is installed in the unit. As such, the unit should not be exposed to operating environments unless the mating connector is installed. In addition, if a wire is not used for each of the 12 pins on the control, a Deutsch 114017 plug must be used in place of each missing wire. Failure to adhere to these guidelines may result in product failure or decreased life.

Use 1 to 1.5 mm² (16 to 18 AWG) stranded copper wire with insulation that meets temperature requirements in the harness design. A wiring harness stress relief within 400 mm (16 inches) of the control's connector is recommended. Limit the distance between the power module and the L-Series actuator to 1 m (3.3 feet) maximum.

Dress the harness with wire loom to contain it in a single bundle. Use grommets when passing the harness through metal panels.

Connector

The following Deutsch connector components are recommended for harness designs:

	Recommended
Mating Connector	DT06-12SB-EP20 (barbed entry point for heat shrink shroud)
Secondary Lock	W12S-P012
Sockets	0462-201-16141, or optionally 0462-201-16141

WARNING

The use of proper wire type and wiring practices is critical to operation.

NOTICE

Do not connect any cable grounds to "instrument ground", "control ground", or any non-earth ground system. Make all required electrical connections based on the wiring diagram (Figures 3-1a and 3-1b).

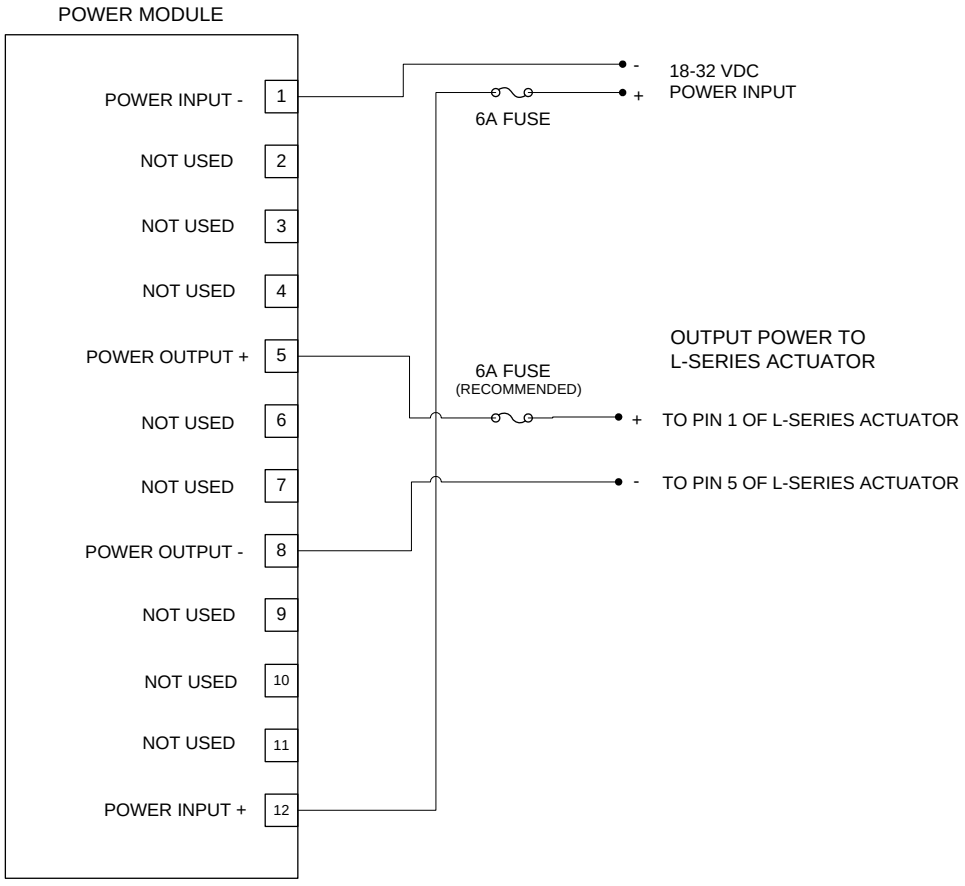
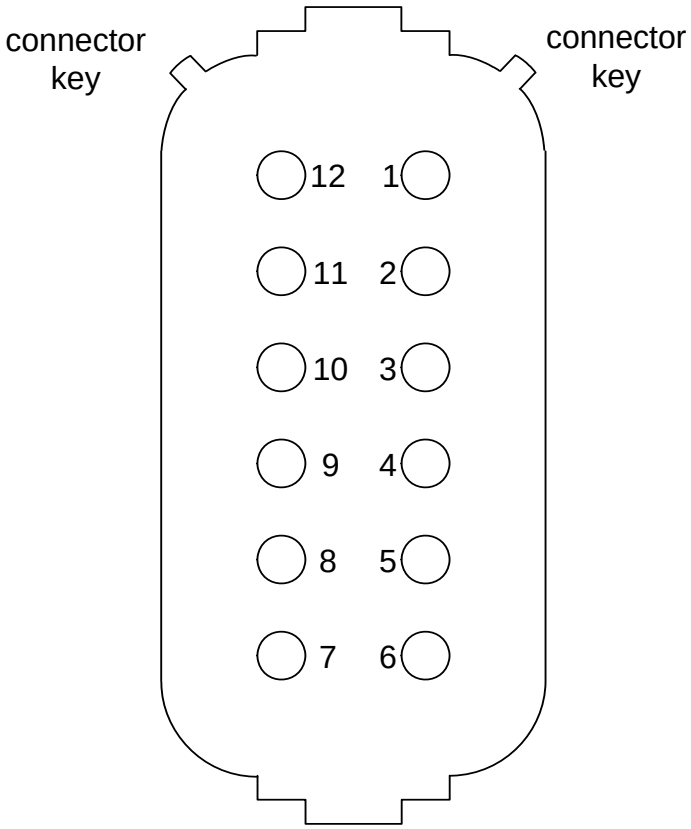


Figure 3-1a. Typical Power Module Application Wiring



Connector Pinout as Viewed
Looking Into
Power Module

Mates with Deutsch # DT06-12SB-EP20

Figure 3-1b. Power Module Connector Pin Arrangement

Connector Pin #	Description	Comment
1	Input Power –	Ground for 18–32 V Input Power
2	No Connection	No Connection
3	No Connection	No Connection
4	No Connection	No Connection
5	Output Power +	Output Power (to L-Series actuator)
6	No Connection	No Connection
7	No Connection	No Connection
8	Output Power –	Ground for Output Power
9	No Connection	No Connection
10	No Connection	No Connection
11	No Connection	No Connection
12	18–32 Vdc Input Power +	18-32 V Input Power

Description of Power Module Electrical I/O

Power Supply Input (18–32 V at pin 12, ground at pin 1)
The power module will handle a voltage range of 18 to 32 Vdc, with brief capability at +80 Vdc (< 2 minutes continuous).

The power supply terminals are reverse polarity protected, and in the case that a reverse polarity condition exists, the power module will not power-up and the output will remain at 0 Vdc.

Woodward recommends using a 6 A fuse on the power supply line feeding pin 12 of the power module.

WARNING

The input power must be fused. Failure to fuse the power module could, under exceptional circumstances, lead to personal injury, damage to the control valve, and/or explosion.

Take special care when wiring the Power Module to adhere to recommended power and grounding practices as illustrated in Figure 3-2.

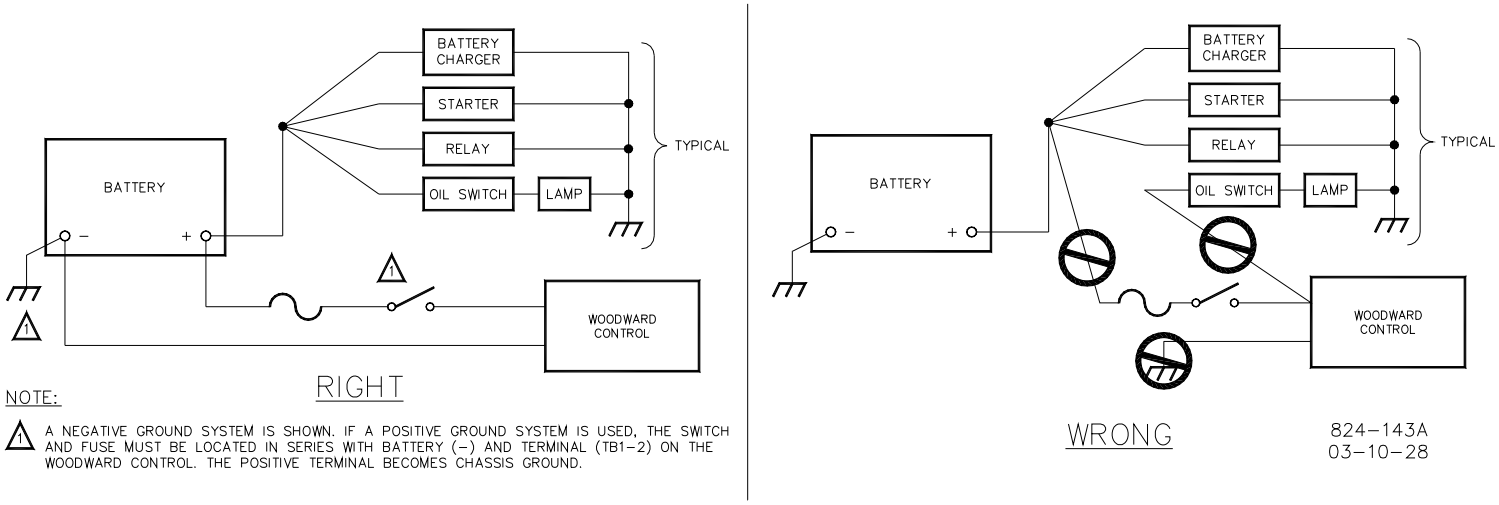


Figure 3-2. Correct and Incorrect Wiring to Power Supply

Power Supply Output (pin 5, referenced to pin 8)
The power module provides a regulated dc output voltage of approximately 14 V, which is intended to supply the power input requirements of the L-Series used in the FCV. To maintain signal integrity in the system, it is recommended that the distance between the power module and the L-Series actuator in the FCV be separated by NO MORE THAN 1 m (3.3 feet).

Although not required, Woodward recommends using a 6 A (fast-blow) fuse on the output as shown in Figure 3-1a.

WARNING

Although not required, Woodward recommends the use of a fuse placed between the output of the power module and the L-Series actuator. In the event of a large current draw downstream of the power module, this fuse will help to protect both the L-Series actuator and the power module.

NOTICE

The power module does not include any on-board diagnostics for loss of output power. Because of this, it is recommended that the end user configure the status output of the L-Series actuator to be active during normal operation. Used in this manner, the loss of the status output of the L-Series actuator can then indirectly annunciate loss of power from the in-line power module.

NOTICE

The power module does not include any on-board diagnostics for direct detection of a wiring fault from input(+) to output(+). If this occurs, it will not harm the power module, but the downstream L-Series actuator will not detect it as a fault unless the input is above 35 Vdc. To aid in detecting this event, it is recommended to implement a direct measurement of L-Series input voltage and monitor it with an external controlling device (an ECM or other engine management system).

Mounting the Power Module

Mounting Location

Locate the power module a distance from sources of extreme radiant heat, such as exhaust manifolds or turbochargers. The operating temperature range of the control is –40 to +105 °C (–40 to +221 °F). In spark-ignited applications, make sure the power module is located away from the ignition coil, and that harness wires are not routed next to the spark plug wires.

To help ensure EMI immunity, the power module housing *must* be mounted in such a way to guarantee a low impedance path from the housing to the machine chassis. This can be in the form of direct metallic contact between the housing and the mounting surface, or it can be accomplished through the use of a robust ground strap. If using a ground strap, it must be a braided strap at a *minimum* of 2.5 cm (1 inch) wide and a *maximum* of 30 cm (12 inches) in length.

As shown in the specifications, the power module has been designed for and verified to a given accelerated life vibration test level at the mounting surface of the actuator. The user should be aware that in any application, bracket design could significantly change the vibration levels at the module. Therefore, every effort should be made to make the bracket as stiff as possible so that engine vibrations are not amplified, creating an even more severe environment at the module.

Mounting Orientation

While it is not a requirement, it is good practice to orient the connector feature on the module in a horizontal or downward orientation to minimize fluid accumulation between the enclosure and the mating connector’s gasket.

Mounting Bolt Pattern

The power module utilizes a 3.312 x 4.062 inch (84.12 x 103.17mm) rectangular mounting bolt pattern and is intended to fit within an envelope of 3.770 x 4.520 x 1.907 inch (95.76 x 114.81 x 48.44 mm). See Figure 3-3.

Mounting Hardware

Use M5 or #10 fasteners torqued to 4 N·m (35 lb-in) to attach the power module to the mounting bracket. Use four #10 external tooth shaped washers to insure proper chassis ground. The bracket and attaching hardware must be designed to hold the weight and to withstand the vibration associated with use in an on-engine environment. Use the appropriate fasteners for securing the mounting bracket to the engine.

IMPORTANT **Use four #10 external tooth shaped washers with the #10 fasteners to insure proper chassis ground.**

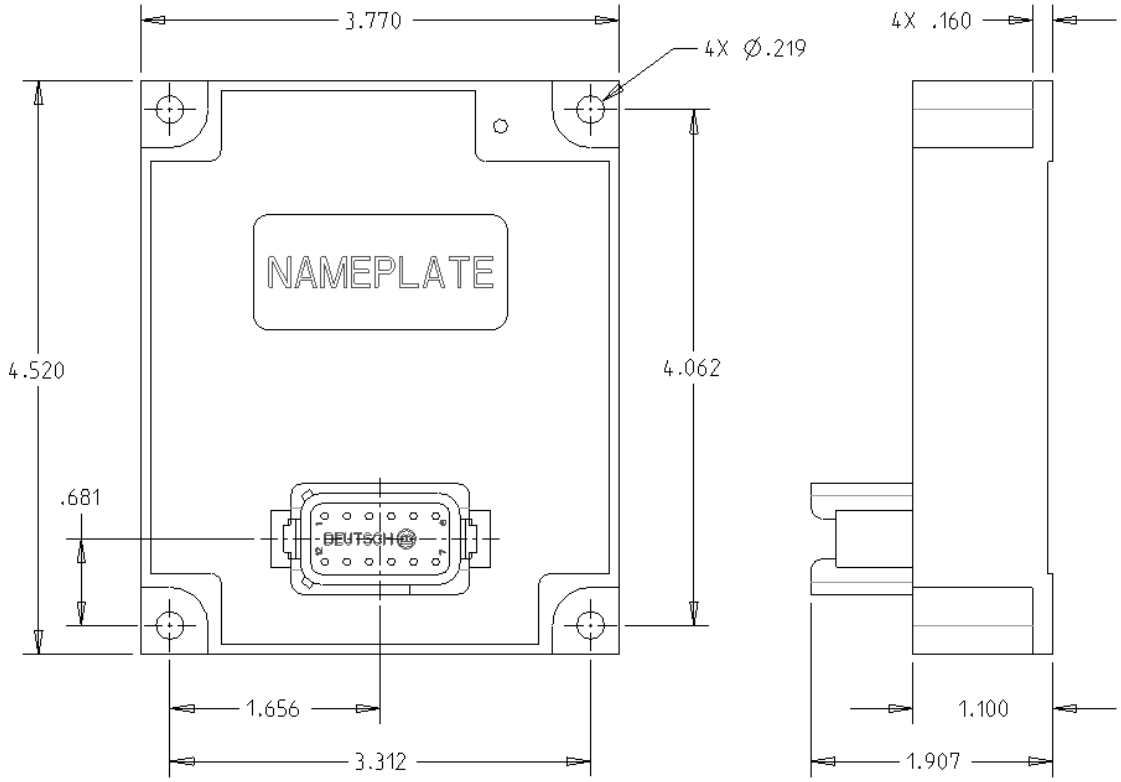


Figure 3-3. Power Module Outline Drawing

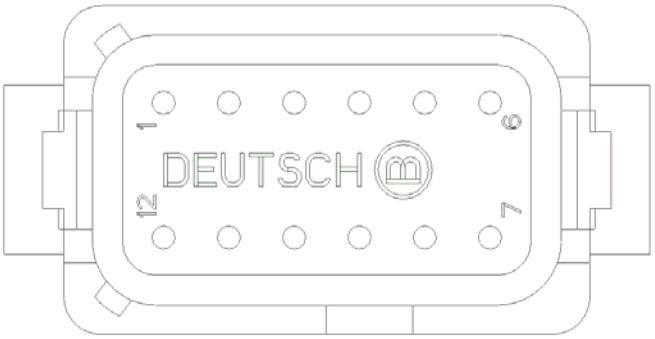


Figure 3-4. Power Module Connector Pins

Chapter 4.
Product Support and Service Options

Product Support Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (**EngineHelpDesk@Woodward.com**) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full-Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at **www.woodward.com/directory**.

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime.

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option, with the exception that the unit will be returned to you in "like-new" condition. This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:
- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:
- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Replacement Parts

When ordering replacement parts for controls, include the following information:
- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact.

Product Training is available as standard classes at many Distributor locations. Customized classes are also available, which can be tailored to your needs and held at one of our Distributor locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact one of the Full-Service Distributors listed at **www.woodward.com/directory**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory published at **www.woodward.com/directory**.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used In Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used In Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used In Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

For the most current product support and contact information, please visit our website directory at **www.woodward.com/directory**.

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number

Prime Mover Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

Type of Fuel (gas, gaseous, diesel, dual-fuel, etc.) _____

Power Output Rating _____

Application (power generation, marine, etc.)

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Symptoms

Description _____

_____

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

Appendix A. Acronyms/Abbreviations

EMC	electromagnetic compatibility
FCV	Fuel Control Valve
I/O	inputs/outputs
L-Series	Woodward electronic engine control that contains both a rotary actuator and a controller circuit board
OEM	original equipment manufacturer

Appendix B.
Power Module Specifications

Specifications

Power Supply	24 V systems (18–32 Vdc) reverse polarity protection, 2 A max
Power Consumption	36 W maximum (2 A at 18 V) at 25 °C
Mass/Weight	499 g (1.1 lb)
Power-Up to Operation Time	<10 ms

Environment

Ambient Operating Temperature	–40 to +105 °C (–40 to +221 °F)
Storage Temperature	–40 to +125 °C (–40 to +257 °F)
EMC	EN61000-6-2: Immunity for Industrial Environments EN61000-6-4: Emissions for Industrial Environments SAE J1113-21: Radiated Immunity (100 V/m) SAE J1113-11: Conducted Transient Immunity – Pulse 5a, Load Dump for 24 V Systems
Humidity	US MIL-STD 810E, Method 507.3, Procedure III
Salt Spray	US MIL-STD 810E, Method 509.3, Procedure I
Shock	US MIL-STD 810F, Method 516.5, Procedure 1 40 G Peak, 11 ms duration sawtooth pulse
Random Vibration	0.3 G²/Hz, 10–2000 Hz (22.1 Grms) 3 hrs/axis
Sine Vibration	5 G 2.5 mm peak-to-peak, 5–2000 Hz, 3 hrs/axis, 90 minute dwells, 1 octave/minute
Drop	SAE J1211, Paragraph 4.8.3 (modified)
Thermal Shock	SAE J1455, Paragraph 4.1.3.2
Ingress Protection	IP56 per EN60529

Power Module

Parameter	Value
Input Voltage Range	18–32 Vdc normal operating. 80 Vdc for 2 minutes.
Input Current	~2 A max
Output Voltage	13.8 Vdc supplied to L-Series actuator
Output Current	3 A max
Start-Up Time	~5 ms with 2.5 A active load
Load Regulation	Output at full load with an 18 Vdc input is approximately 11 Vdc (adequate to ensure full torque output of an L-Series actuator). Nominal regulation at 24 V, with a controlling actuator is approximately 13.8 Vdc.
Isolation, Input to Output	None
Switching Frequency	~250 kHz
Output Voltage Ripple	<100 mV over line and load conditions
Reverse-Input-Polarity Protection	Yes

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26283.

PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

Email and Website—www.woodward.com

**Woodward has company-owned plants, subsidiaries, and branches,
as well as authorized distributors and other authorized service and sales facilities throughout the world.**

Complete address / phone / fax / email information for all locations is available on our website.

2012/9/Colorado